State of California

Business, Transportation and Housing Agency

Memorandum

To: MR. RAMIN RASHEDI
Division of Structure Design
Design Office 59-232

Attention: Mr. Gary Blakesley

Date: May 5, 2000

File: 11-SD-5-KP 51.18
11-0301U1

Carmel Mountain Road U.C. (Widen & Outer Right)
Bridge No. 57-0314R/L/S

From: **DEPARTMENT OF TRANSPORTATION**
ENGINEERING SERVICE CENTER
Division of Structural Foundations - MS 5
Office of Structure Foundations

Subject: Revised Foundation Recommendations

Introduction

The proposed Carmel Mountain Road UC Right and Left Widenings (Br. No. 57-0314R/L) and addition of a new northbound bridge [Carmel Mountain Road UC Outer Right (Br. No. 57-0314S)] are part of planned Route 5 Freeway improvements for the San Diego area. The proposed improvements will be located approximately 1.9 km (1.18 mi) north of the Rte. 5/805 Interchange area. A request for Final Foundation Recommendations (FR), dated October 22, 1998, for the subject bridge outside widenings and new outer right bridge was submitted to the Office of Structural Foundations (OSF) by Mr. Rashedi. Site specific ARS, liquefaction potential, and methods of liquefaction mitigation were requested in the above memorandum. A list of preliminary column/pile loads and shaft diameters were provided to OSF by Mr. Rashedi, dated December 18, 1998. As the 5/805 and 5/56 project has progressed, further revisions of the above pile load and shaft diameter list was sent to OSF including Revision 1 (dated February 24, 1999), Revision 2 (dated April 9, 1999), and Revision 3 (dated May 11 and 26, 1999). Final pile loads and diameters were provided by Mr. Rashedi (personal communication, September 1999). Mr. Gary Blakesley provided final bottom of footing elevations for the proposed widening and new outer right bridge (Caltrans facsimile copy, dated February 9, 2000). P-Y curves were also requested by Mr. Earl Seaberg on February 24, 1999. In the same memorandum liquefaction potential was considered very low and 610 mm (24 in) diameter cast-in-drilled-hole (CIDH) piles with pile cap were requested to be used at the Carmel Mountain Road bridges.

Subsurface information was obtained by OSF drilling 4 - mud rotary borings (94 to 114 mm diameter) which also involved some coring and completing 2 - 25 mm (1 in) diameter soil tube tests. Information from an additional 3 - mud rotary borings (drilled nearby) were provided by Mr. Jeff Tesar (Roadway South). Results from the field studies will be shown on the Log of Test Borings (LOTBs). In addition to the recent field work, the As Built LOTBs for the Carmel Mountain Road UC, Br. No. 57-314 (Contract No. 11-022454, signed July 20, 1964), contained additional site and subsurface information and will be included within the new contract plans.

Site Description

Left Bridge (Widen):

The existing abutments are partially founded in approach embankment fill material which ranges between approximately 4.9 and 12.2 m (16 to 40 ft) thick, thinning drastically to the north. Underlying native material ranges from 0 to 4.0 m (0 to 13 ft) thick and thins to the north. The top surface of the underlying Eocene Torrey Sandstone slopes south beneath the fill and native sediments from approximate elevation +22.9m (+75 ft) on the north side of Carmel Mountain Road (Boring 99-4) to elevation +15.2 m (+50 ft) on the south side of the road.

Artificial fill consists of very loose to medium dense, sand and silty fine sand with scattered gravel and minor cobbles [up to 150 mm (6 in) diameter] interlayered with rare firm sandy lean clay. Native material (mapped as Holocene alluvium and slope wash undifferentiated) according to Kennedy (1975), consists of very dense, gravel with silty sand matrix and medium dense/stiff, sandy silt and lean clay interbeds. The underlying Torrey Sandstone consists of interbedded very soft to moderately hard, fine to medium sandstone, silty sandstone, mudstone, claystone, and minor conglomerate [containing mostly hard metavolcanic gravel and cobbles up to 150 mm (6in) diameter]. The formation is often intensely weathered, uncemented to moderately cemented, indurated but commonly with soil-like properties. Pelecypods were concentrated mostly within mudstone interbeds. The maximum boring depth for the left bridge widening (Boring 99-4) was 30.48 m (100 ft) below the surface [approximate elevation -6.07 m (-19.9 ft)].

Right Bridge (Widen and Outer Right):

The existing abutments are partially founded in approach embankment fill material although the north abutment may also be partially founded in native material or sandstone. Embankment fill ranges between an estimated 0.6 to 11.9 m (2 to 39 ft) thick, pinching out to the north where native fine sand sporadically overlies Torrey Sandstone which also outcrops at the surface. OSF borings show artificial fill (Boring 99-1) at approximately 8.8 m (29 ft) thick maximum. Native material (which partially underlies fill and road base material and also lies at the surface) ranges from 0.5 to 2.1 m (1.6 to 7 ft) thick and thins to the north. The underlying top surface of the Eocene Torrey Sandstone slopes south beneath the native sediments from approximately elevation +29.9m (+98 ft) on the north side of Carmel Mountain Road (Soil tube 99-3) to elevation +15.2 m (+50 ft) south of the road (Boring 99-1). Artificial fill consists of medium dense to very dense, fine to coarse sand with scattered gravel and gravel-size claystone/mudstone fragments interlayered with minor thin lenses of stiff clay and sandy silt. Native material (mapped as Holocene alluvium and slope wash undifferentiated) according to Kennedy (1975), consists of medium dense, silty sand with gravel and minor fine sand. The underlying Torrey Sandstone consists of interbedded generally very soft to soft, fine to medium sandstone, silty sandstone, mudstone, and claystone. The formation is often intensely weathered, uncemented to moderately cemented, indurated but commonly with soil-like properties. Pelecypod fragments were concentrated mostly within mudstone and sandstone interbeds. The maximum boring depth for the right bridge widening and new outer right bridge (Boring 99-1) was 24.5 m (80.5 ft) below the surface [approximate elevation +1.6 m (+5.3 ft)]. The LOTB should be consulted for details.

Ground Water

Static ground water was last measured on January 11, 2000, within Boring 99-1(near Abutment 1 right bridge widen and outer right) at elevation +13.01 m (+42.7 ft). The water level within Boring 99-1 did not vary more than 0.03 m (0.1 ft) repeatedly measured over 7 months time. Also, downhole compression or primary waves showed significant deflection, with corresponding very little deflection of shear waves or change in lithology at the same depth, at approximate elevation +10.67 m (+35 ft) within boring 99-4 (near Abutment 4 left side widen) and probably indicate water at this elevation within the Torrey Sandstone. Apparently, significant irrigation introduced from housing developments occurs on the slope above the bridge and may be the major source of this ground water.

The As Built LOTB shows no ground water was encountered to approximate elevation +13.1 m (+43 ft) based on the City of San Diego datum, which requires a +2.47 m (+8.12 ft) add (Schuh, Caltrans E-mail and Memorandum, February 14 and March 7, 2000)to adjust to the current metric datum (NAVD 88) upon which the recent plans and boring program are based. The adjusted to metric As Built elevations would then show no ground water encountered to elevation +15.58 m (+51.1 ft) for the earlier foundation investigation.

Seismicity

See the memorandums (dated February 10, 1999) concerning Preliminary Seismic Design Recommendations sent to Mr. Earl Seaberg from Mr. Ron Jones and Dr. Abbas Abghari (Office of Geotechnical Earthquake Engineering). Final Seismic Design Recommendations and Lateral Resistance, p-y Curves will be submitted by the Office of Geotechnical Earthquake Engineering.

As mentioned above (Jones and Abghari, February 10, 1999) the proposed "structures are located approximately 5 km from the Newport-Inglewood-Rose Canyon fault which has a maximum credible earthquake moment magnitude of M=7.0 and based on the Caltrans California Seismic Hazard Map (Mualchin, 1996), these structures are within the peak horizontal bedrock acceleration zone of 0.5 g."

Approximate depth to pseudo-rock-like material [Vs greater than 549 to 671 meters per second (1800 to 2200 fps)] occurs at 23.8 m (78 ft) [elevation +0.6 m (+2 ft)] within Boring 99-4.

Liquefaction

Liquefaction potential is considered very low. Material at the site is dominantly composed of medium dense to very dense granular sediments and soft weak formational sandstone/siltstone/claystone. Ground water is also significantly deep [approximately 13.1 m (43 ft) below the surface].

Foundation Recommendations

The following recommendations are based on the Carmel Mountain Road UC (Widen and Outer Right), General Plans (Revised June 24, 1999, and April 28, 1999, respectively), and Foundation Plans (checked by S. Wang, December 1998), the above mentioned memorandums and personal communications from Mr. Rashedi (Caltrans facsimile copy dated May 26, 1999 and personal communications regarding pile loads and pile diameter, September 1999) and Mr. Blakesley (Caltrans facsimile copy with final bottom of footing elevations, dated February 9, 2000).

For the Right sliver widening, sliver fills can be placed in accordance with Section 19-6 of the Standard Specifications. End dumping is not permitted. Any settlement due to the addition of the sliver fills should be negligible in the foundation soils as existing embankment has been in place since 1966 and native soils/formational material are generally medium dense (compact) to soft (very dense) formational material.

For the proposed Outer Right bridge, additional fill is estimated to range from 8.23 to 5.79 m (27 to 19 ft) maximum height at Abutments 1 and 2, respectively. Again, all fills can be placed in accordance with the Section 19-6 of the Standard Specifications. Calculated maximum settlements (Hough's Method) range from 51 to 35 mm (2.0 to 1.4 in) at Abutments 1 and 2, respectively. OSF recommends a fill settlement of up to 30 days; however, the actual settlement period will be determined by the project engineer on the basis of settlement data in the field.

For the Left side widening, additional fill is estimated to range from 10.67 to 7.01 m (35 to 23 ft) maximum height at Abutments 1 and 4, respectively. Calculated maximum settlements (Hough's Method) range from 79 to 38 mm (3.1 to 1.5 in) at Abutments 1 and 4, respectively. Again, OSF recommends a fill settlement of up to 30 days, but the actual settlement period will be determined by the project engineer as noted above.

Structure Approach Type N(9D) slabs will be incorporated within the Left bridge widen and Structure Approach Type N(9S) slabs will be incorporated within the Right bridge widen and Outer Right bridge as shown on the General Plans.

Plumb, 600 mm (24 in) diameter, Cast-in-Drilled-Hole (CIDH) Piles can be used for the bridge widenings and new Outer Right bridge at abutment and bent supports as shown below. CIDH pile capacities were calculated using the Federal Highway Administration's Drilled Shaft Manual (Pub. No. FHWA-HI-88-042) published July 1988. Final design loading (Working Stress Design) at the abutments and nominal resistance (Load Factor Design) at the bents were supplied by the DSD (Rashedi, facsimile copy and personal commun., Revision 3, May 26 and September, 1999). Mr. Blakesley (February 9, 2000) provided final bottom of footing elevations.

Left Bridge Widen

Support Location/ Type & Diameter	Design Loading			Nominal Resistance		Elevation		Specified Tip Elevation m (ft)
	Compression kN (tons)	Tension kN (tons)	Lateral kN (tons)	Compression kN (tons)	Tension kN (tons)	Bottom of Pile Footing m (ft)	Design Tip m (ft)	
Abut 1/CIDH 600 mm (24 in)	N/A			**1250 (140)**	**0**	+30.25 (+99.3) in fill	+11.28 (1) (+37.0) (1)	+11.28 (+37.0)
Bent 2/CIDH 600 mm (24 in)				**1250 (140)**		+18.50 (+60.7) in fill	+10.97 (1) (+36.0) (1)	+10.97 (+36.0)
Bent 3/CIDH 600 mm (24 in)				**1250 (140)**		+17.50 (+57.4) in ntv. mtl.	+10.06 (1) (+33.0) (1)	+10.06 (+33.0)
Abut 4/CIDH 600 mm (24 in)	N/A			**1250 (140)**	**0**	+30.00 (+98.4) in fill	+16.76 (1) (+55.0) (1)	+16.76 (+55.0)

Notes: Design tip elevation is controlled by the following demands: 1) Compression, 2) Tension, and 3) Lateral Loads

Right Bridge Sliver Widen

Support Location/ Type & Diameter	Design Loading			Nominal Resistance		Elevation		Specified Tip Elevation m (ft)
	Compression kN (tons)	Tension kN (tons)	Lateral kN (tons)	Compression kN (tons)	Tension kN (tons)	Bottom of Pile Footing m (ft)	Design Tip m (ft)	
Abut 1/CIDH 600 mm (24 in)	N/A			**1250 (140)**	0	+29.00 (+95.1) in fill	+12.50 (1) (+41.0) (1)	+12.50 (+41.0)
Bent 2/CIDH 600 mm (24 in)				**1250 (140)**		+22.50 (+73.8) in fill	+11.89 (1) (+39.0) (1)	+11.89 (+39.0)
Bent 3/CIDH 600 mm (24 in)				**1250 (140)**		+22.50 (+73.8) in ntv. mtl.	+16.15 (1) (+53.0) (1)	+16.15 (+53.0)
Abut 4/CIDH 600 mm (24 in)	N/A			**1250 (140)**	0	+29.25 (+96.0) in ntv. mtl.	+22.56 (1) (+74.0) (1)	+22.56 (+74.0)

Notes: Design tip elevation is controlled by the following demands: 1) Compression, 2) Tension, 3) Lateral Loads
in ntv. mtl. = in native material

Outer Right Bridge

Support Location/ Type & Diameter	Design Loading			Nominal Resistance		Elevation		Specified Tip Elevation m (ft)
	Compression kN (tons)	Tension kN (tons)	Lateral kN (tons)	Compression kN (tons)	Tension kN (tons)	Bottom of Pile Footing m (ft)	Design Tip m (ft)	
Abut 1/CIDH 600 mm (24 in)	N/A			**1800 (200)**	**0**	+28.87 (+94.7) in fill	+10.67 (1) (+35.0) (1)	+10.67 (+35.0)
Abut 2/CIDH 600 mm (24 in)	N/A			**1800 (200)**	**0**	+28.67 (+94.1) in ntv. mtl.	+19.51 (1) (+64.0) (1)	+19.51 (+64.0)

Notes: Design tip elevation is controlled by the following demands: 1) Compression, 2) Tension, 3) Lateral Loads
in ntv. mtl. = in native material

When pile nominal resistance in tension is provided by DSD, OSF can then provide design pile tip elevations in tension. Also, if the pile tip elevation is controlled by lateral demands, the designer is responsible to present correct foundation data, governed by lateral control, on the foundation plans.

The above pile capacities are based on skin friction only. OSF feels that even though many borings should be dry, anticipated moderate caving may make it difficult to realize substantial end bearing using Caltrans standard pile vertical deflection criteria of 13 mm (0.5 in). End bearing was not used for the above CIDH axial pile load bearing capacities

Constructability

Moderate caving and hard slow drilling [drilling through hard metavolcanic cobble zones (cobbles up to 150 mm diameter)] is anticipated during installation of CIDH piles. Some ground water should be anticipated during CIDH pile construction. The wet method is advised for CIDH pile construction when specified pile tip elevations are near elevation +13.01 m (+42.7 ft) for the Right Bridge Widen and Outer Right Bridge. For the Left Bridge Widen, the wet method is advised when specified pile tip elevations are near an estimated elevation of +10.67 m (+35.0 ft). The bottom of all excavations should be cleaned of loose debris before placing concrete. Due to recent development in the area and local irrigation, ground water could be encountered at a higher elevation than was measured during this investigation.

Corrosiveness

Laboratory tests of composite soil samples indicate that combined fill and native material is corrosive. Corrosion tests on the above material show pH measured at 5.96, minimum resistivity of 678 ohm-cm, sulfate and chloride content of 400 and 1200 ppm, respectively, and the estimated number of years to perforation of 18 gauge galvanized steel culvert is 21 years. OSF feels that the Corrosion Technology Branch should be consulted regarding test results and possible recommendations.

If you have any questions, please call Joe Pratt at (213) 620-2001 or Richard Fox at (916) 227-7085.

Report by:

Joseph S. Pratt

JOSEPH S. PRATT, C.E.G. No. 2141
Associate Engineering Geologist

REGISTERED GEOLOGIST
JOSEPH S. PRATT
No. 2141
Exp. 05/31/01
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

c: R.E. Pending File
DBarlow - Specs & Estimates
HBrimhall - Proj Mgmt
District 11 (2)
ELeivas - OSF
RFox - OSF
AAbghari - OGEE
DParks – Corrosion Technology

References

Blakesley, G., February 9, 2000, Final Bottom of Footing Elevations for Carmel Mountain Road UC (Widen and Outer Right), Br. No. 57-0314R/L/S, Caltrans facsimile copy.

Jones, R., and Abghari, A., April 7, 1999, Preliminary Lateral Resistance, p-y curves, Carmel Mountain Road UC (Widen), Br. No. 57-0314R/L, Caltrans Memorandums.

Jones, R., and Abghari, A., February 10, 1999, Preliminary Seismic Design Recommendations, Carmel Mountain Road UC (Widen and Outer Right), Br. No. 57-0314R/L/S, Caltrans Memorandums.

Kennedy, Michael P., 1975, Geology of the San Diego Metropolitan Area, California, Calif. Div. Mines and Geology Bull. 200, Geologic Map of the Del Mar 7.5 minute Quadrangle, Scale 1:24,000.

Mualchin, L., 1996, A technical report to accompany the Caltrans California Seismic Hazard Map 1996 (based on maximum credible earthquakes), Calif. Dept. of Transportation, Engineering Service Center, Office of Earthquake Engineering, Sacramento, CA, revision 1 (July 1996), 64 p., with accompanying map.

Pratt, J., January 5, 1999, Request for Seismic Information, Liquefaction Potential and Mitigation, and Lateral Pile Capacities, Caltrans Memorandum.

Rashedi, R., September 1999, personal commun., Final Pile Loads and Pile Diameter at Carmel Mountain Road UC (Widen and Outer Right), Br. No. 57-0314R/L/S.

Rashedi, R., October 22, 1998, Request for Final Foundation Recommendations for I-5 widening and interchange improvement at Route 5/805 and Route 5/56 in San Diego County, Caltrans Memorandum.

Rashedi, R., May 11 and 26, 1999, Revision 3: List of Preliminary Column/Pile Loads and Shaft Diameters at 5/805 and 5/56 Interchanges, Caltrans facsimile copy.

Rashedi, R., April 9, 1999, Revision 2: List of Preliminary Column/Pile Loads and Shaft Diameters at 5/805 and 5/56 Interchanges, Caltrans facsimile copy.

Rashedi, R., February 24, 1999, Revision 1: List of Preliminary Column/Pile Loads and Shaft Diameters at 5/805 and 5/56 Interchanges, Caltrans facsimile copy.

Rashedi, R., December 18, 1998, List of Preliminary Column/Pile Loads and Shaft Diameters at 5/805 and 5/56 Interchanges, Caltrans facsimile copy.

Schuh, G., March 7, 2000, Confirmation of Datums Used on As Built Plans and Elevation Add to Adjust City of San Diego Datum to NGVD 29 Datum (MSL), Caltrans Memorandum, District 11 Surveys.

Schuh, G., February 14, 2000, Correct Elevation Add to NGVD 29 Datum (English) Used on As Built Plans to Adjust to NAVD 88 Datum (Metric), Caltrans facsimile copy, District 11 Surveys.

Seaberg, E., February 24, 1999, Request for P-Y Curves for 5/805 and selected 5/56 Bridges, Caltrans Memorandum.

U.S. Dept. of Transportation, Federal Highway Administration Pub. No. FHWA-HI-88-042, July 1988, Drilled Shafts, Student Workbook, National Highway Institute Course No. 13214.